Title: CONTROL APPARATUS AND METHOD FOR TAKING FAILURE COUNTERMEASURE FOR HYBRID VEHICULAR DRIVE SYSTEM
Inventor(s): Kazuo YATABE et al.
DOCKET NO.: 023971-0314

FIG.1

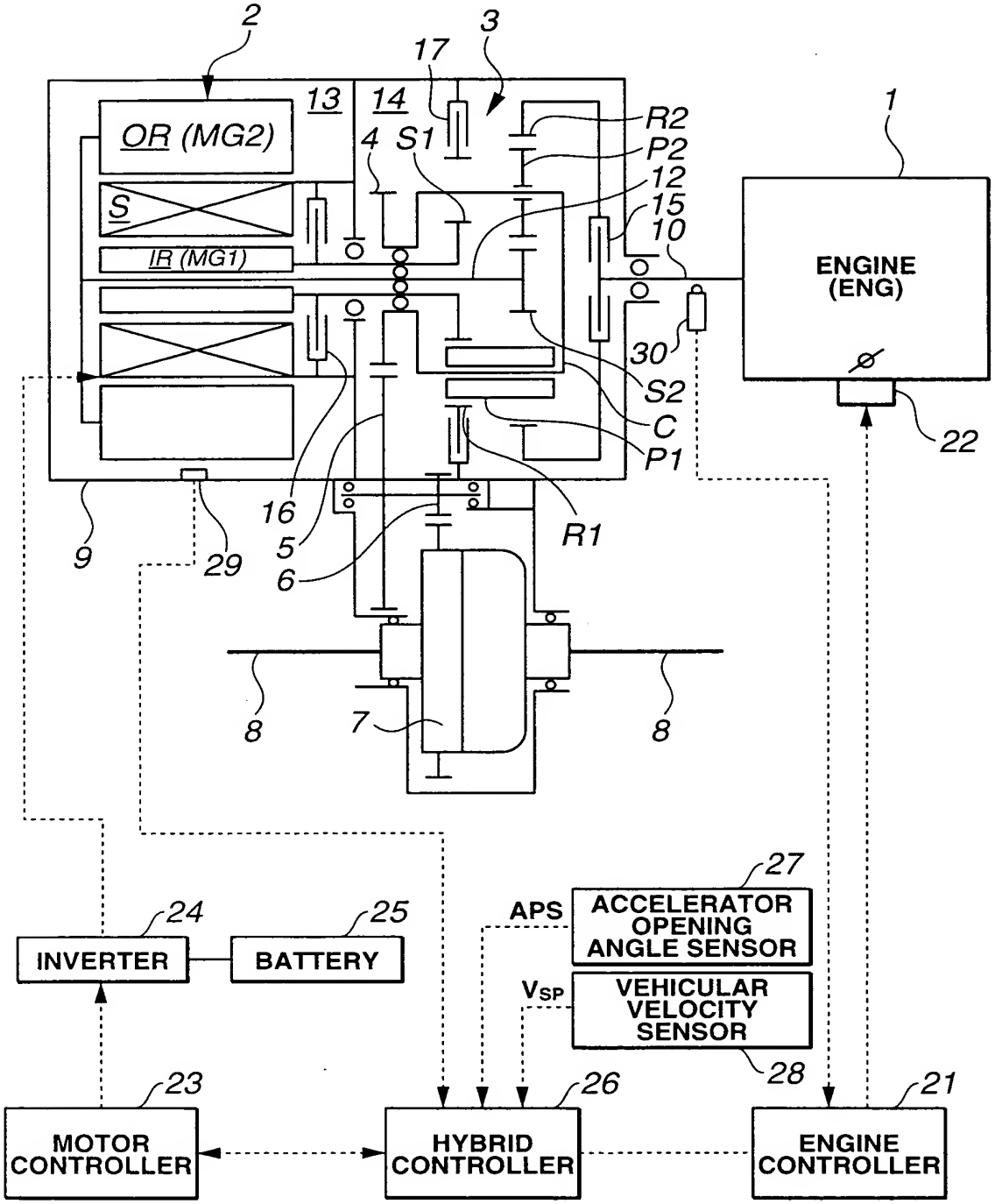

FIG.2

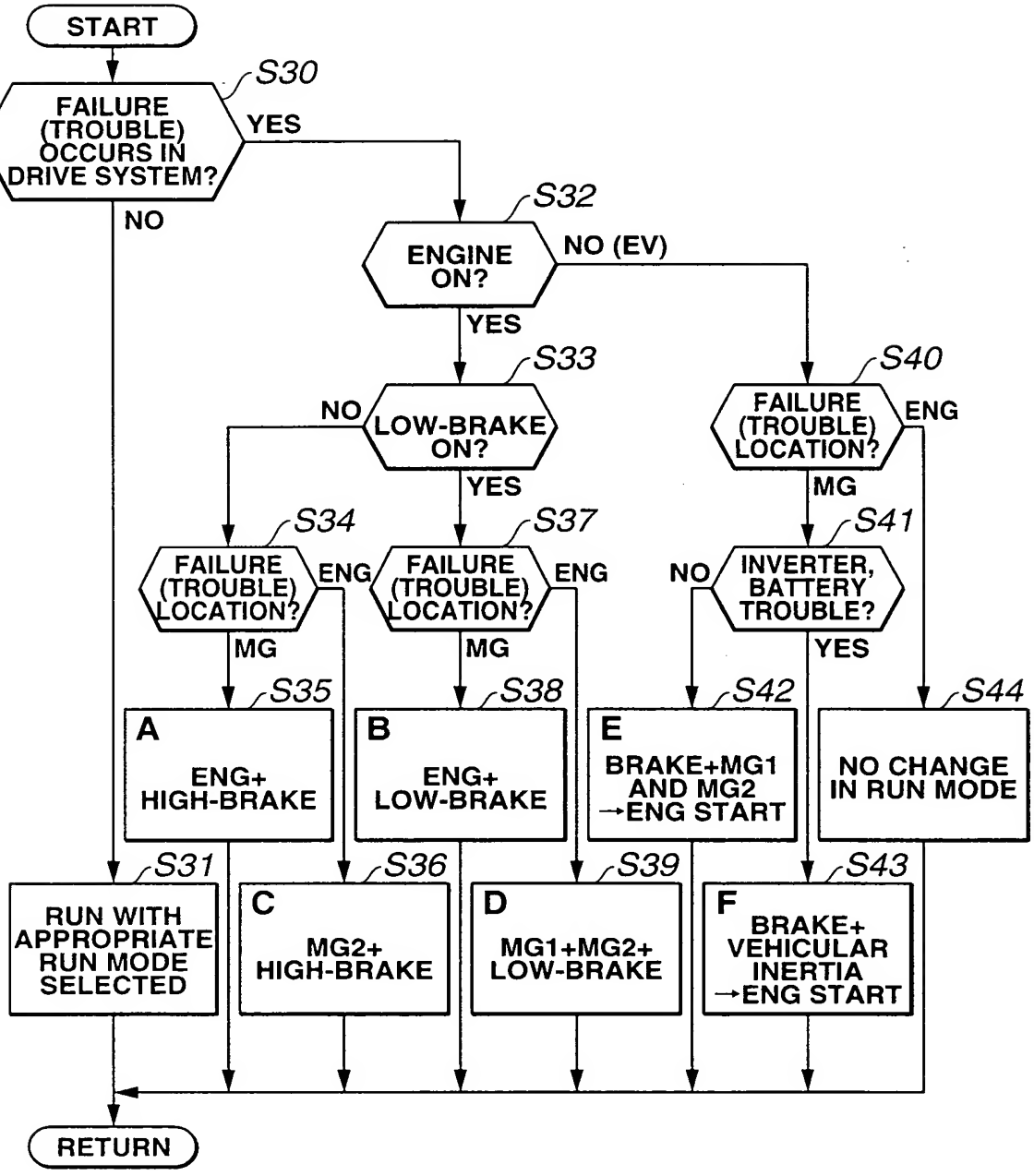
START
S30
FAILURE (TROUBLE) OCCURS IN DRIVE SYSTEM?
YES
NO
S32
ENGINE ON?
NO (EV)
YES
S33
NO
LOW-BRAKE ON?
YES
S40
FAILURE (TROUBLE) LOCATION?
ENG
MG
S34
FAILURE (TROUBLE) LOCATION?
ENG
MG
S37
FAILURE (TROUBLE) LOCATION?
ENG
MG
S41
NO
INVERTER, BATTERY TROUBLE?
YES
S35
A
ENG+ HIGH-BRAKE
S38
B
ENG+ LOW-BRAKE
S42
E
BRAKE+MG1 AND MG2 →ENG START
S44
NO CHANGE IN RUN MODE
S31
RUN WITH APPROPRIATE RUN MODE SELECTED
S36
C
MG2+ HIGH-BRAKE
S39
D
MG1+MG2+ LOW-BRAKE
S43
F
BRAKE+ VEHICULAR INERTIA →ENG START
RETURN

FIG.3

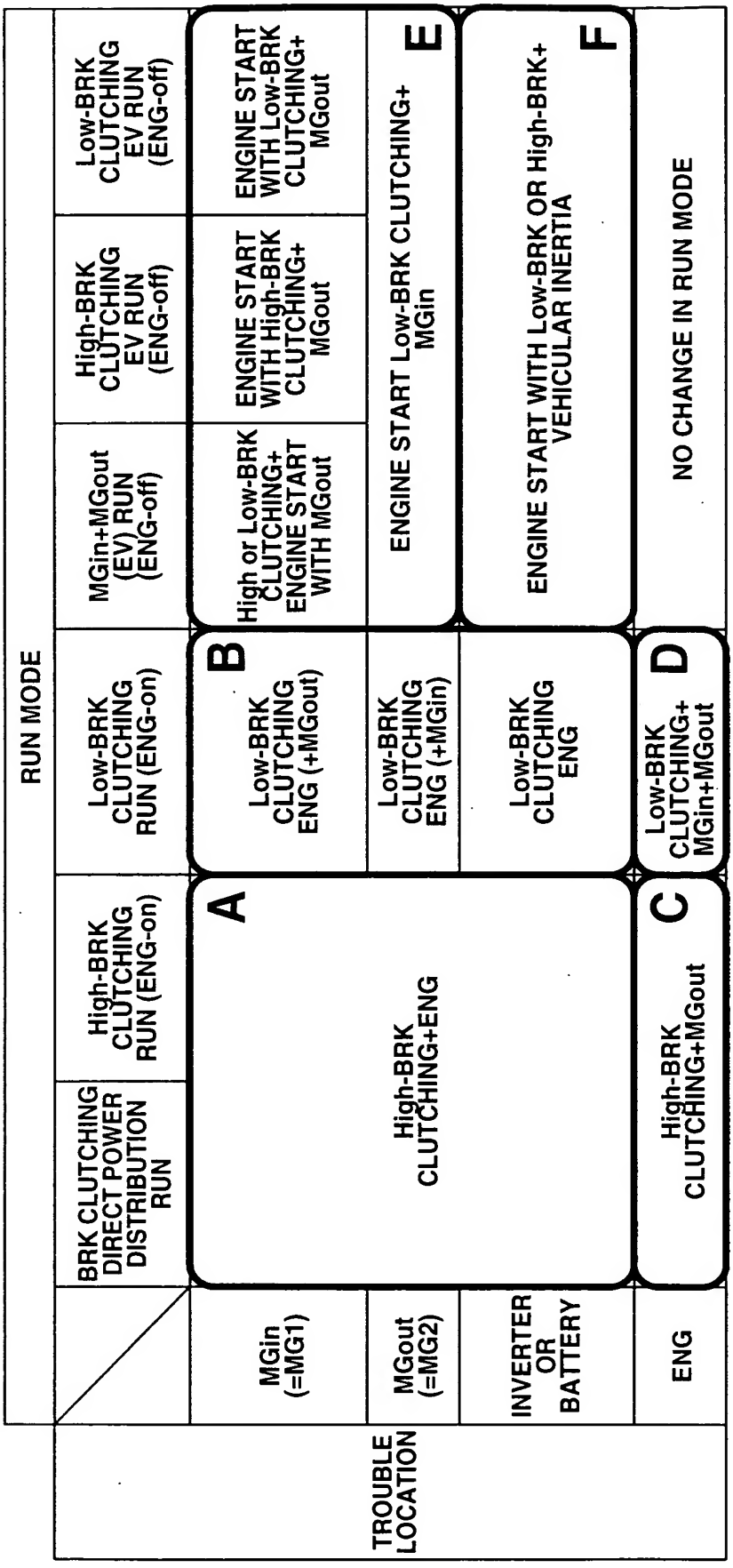
RUN MODE
BRK CLUTCHING DIRECT POWER DISTRIBUTION RUN
High-BRK CLUTCHING RUN (ENG-on)
Low-BRK CLUTCHING RUN (ENG-on)
MGin+MGout (EV) RUN (ENG-off)
High-BRK CLUTCHING EV RUN (ENG-off)
Low-BRK CLUTCHING EV RUN (ENG-off)
TROUBLE LOCATION
MGin (=MG1)
MGout (=MG2)
INVERTER OR BATTERY
ENG
A
High-BRK CLUTCHING+ENG
B
Low-BRK CLUTCHING ENG (+MGout)
High or Low-BRK CLUTCHING+ ENGINE START WITH MGout
ENGINE START WITH High-BRK CLUTCHING+ MGout
ENGINE START WITH Low-BRK CLUTCHING+ MGout
E
ENGINE START Low-BRK CLUTCHING+ MGin
Low-BRK CLUTCHING ENG (+MGin)
F
ENGINE START WITH Low-BRK OR High-BRK+ VEHICULAR INERTIA
Low-BRK CLUTCHING ENG
C
High-BRK CLUTCHING+MGout
D
Low-BRK CLUTCHING+ MGin+MGout
NO CHANGE IN RUN MODE

FIG.4

TROUBLE LOCATION	TROUBLE DETERMINATION
MG INNER (ROTOR) MG OUTER (ROTOR)	1) DETERMINE MG ERROR ACCORDING TO MC FAILURE SIGNAL 2) DETERMINE ERROR FROM A RESULT OF COMPARISON OF COMMAND REVOLUTION SPEED AND OUTPUT AXLE REVOLUTION SPEED 3) DETERMINE ERROR FROM A RESULT OF COMPARISON BETWEEN COMMANDED TORQUE AND A TIME DIFFERENTIAL VALUE OF OUTPUT SPEED
INVERTER	1) DETERMINE INV ERROR ACCORDING TO MC FAIL SIGNAL 2) DETERMINE INV ERROR BY COMPARING POWER ON ERROR (CURRENT AND VOLTAGE) AT THE DC SIDE POWER SUPPLY (CURRENT/VOLTAGE) WITH OUTPUT ERROR AT AC SIDE
ENGINE	1) DETERMINE ERROR ACCORDING TO FAILURE SIGNAL OF ENGINE CONTROLLER 2) DETERMINE ERROR BY COMPARING A COMMAND SPEED WITH A UNIT INPUT SPEED
BATTERY	1) DETERMINE ERROR ACCORDING TO FAILURE SIGNAL OF BATTERY CONTROLLER 2) DETERMINE ERROR BY COMPARING HCM ACCUMULATED VALUE WITH BATTERY OUTPUT VOLTAGE

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FIG.5

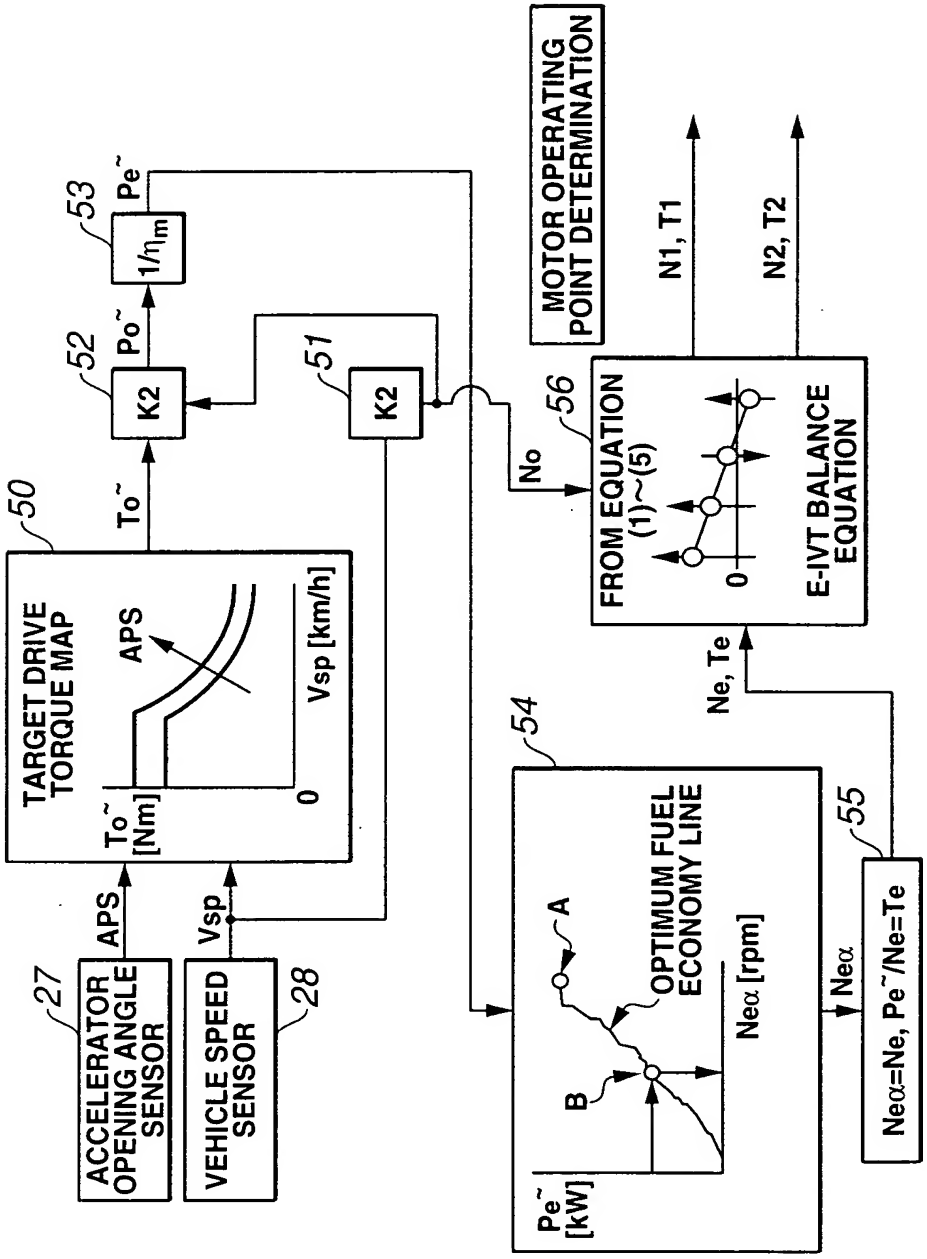

MOTOR OPERATING POINT DETERMINATION
N1, T1
N2, T2
53
Pe~
1/ηm
52
Po~
K2
51
K2
50
To~
TARGET DRIVE TORQUE MAP
APS
To~ [Nm]
Vsp [km/h]
0
No
56
FROM EQUATION (1)~(5)
E-IVT BALANCE EQUATION
Ne, Te
54
A
B
OPTIMUM FUEL ECONOMY LINE
Neα [rpm]
Pe~ [kW]
Neα
55
Neα=Ne, Pe~/Ne=Te
APS
Vsp
27
ACCELERATOR OPENING ANGLE SENSOR
VEHICLE SPEED SENSOR
28

FIG.6

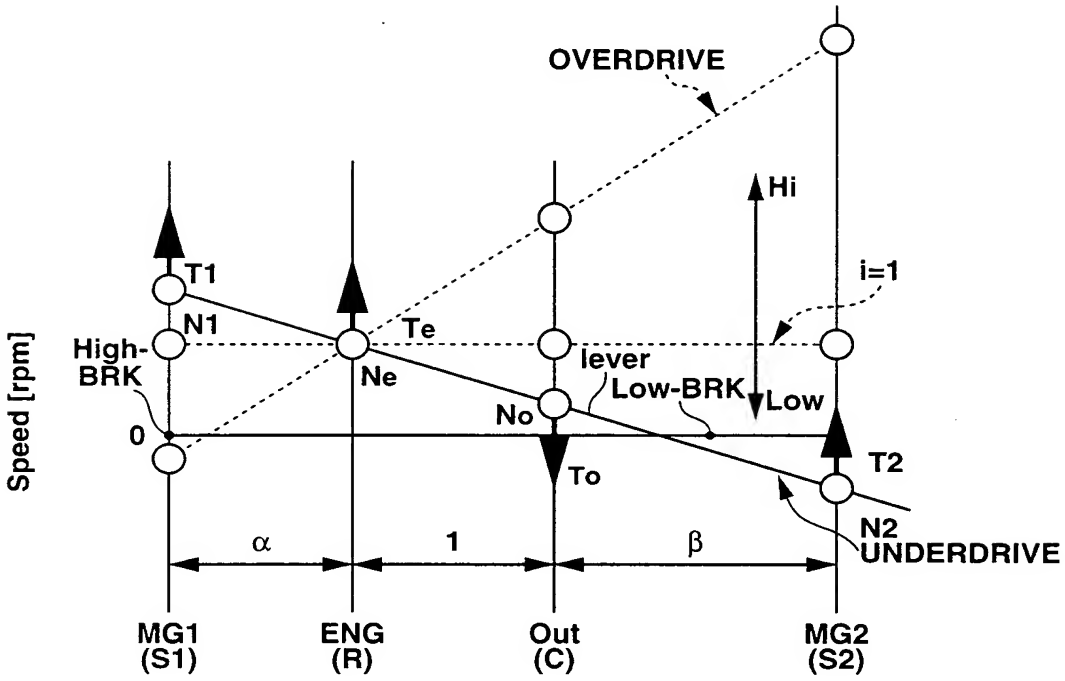

OVERDRIVE
Hi
i=1
T1
N1
Te
High-
BRK
Ne
lever
Low-BRK
Low
No
0
To
T2
N2
UNDERDRIVE
Speed [rpm]
α
1
β
MG1
(S1)
ENG
(R)
Out
(C)
MG2
(S2)

FIG.7

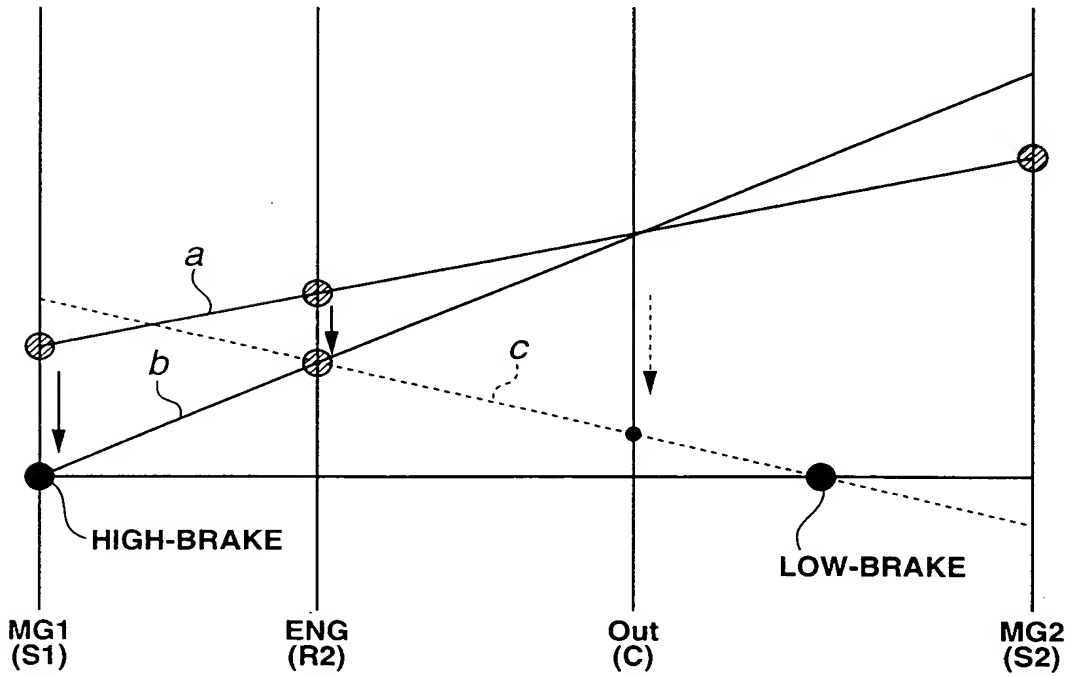

a
b
c
HIGH-BRAKE
LOW-BRAKE
MG1
(S1)
ENG
(R2)
Out
(C)
MG2
(S2)

FIG.8

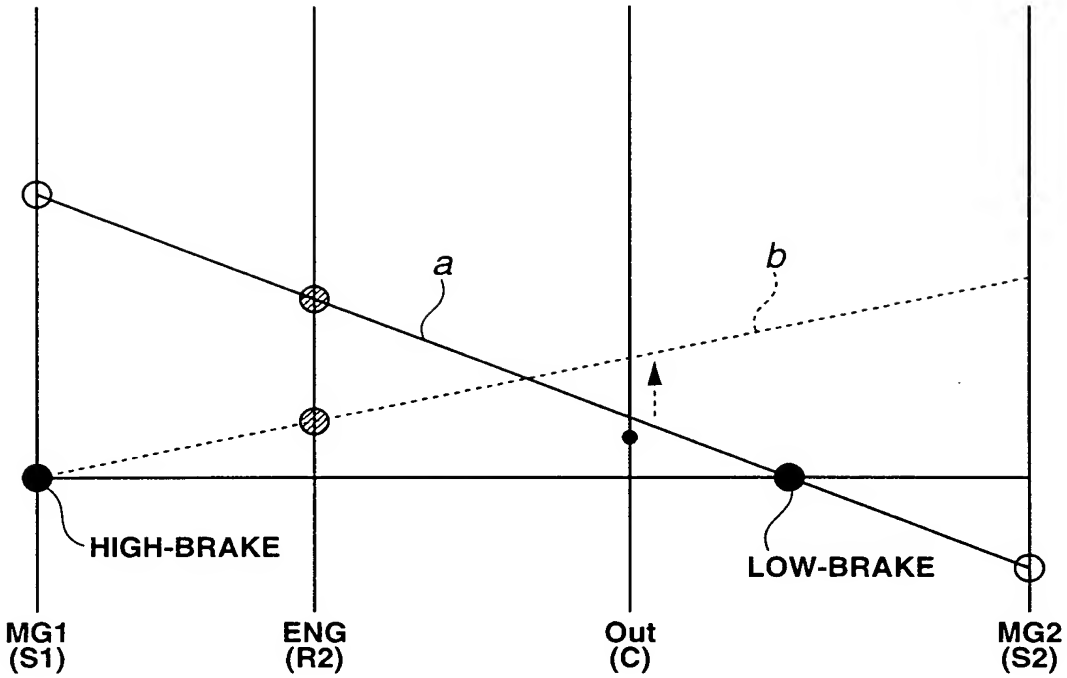

a
b
HIGH-BRAKE
LOW-BRAKE
MG1
(S1)
ENG
(R2)
Out
(C)
MG2
(S2)

FIG.9

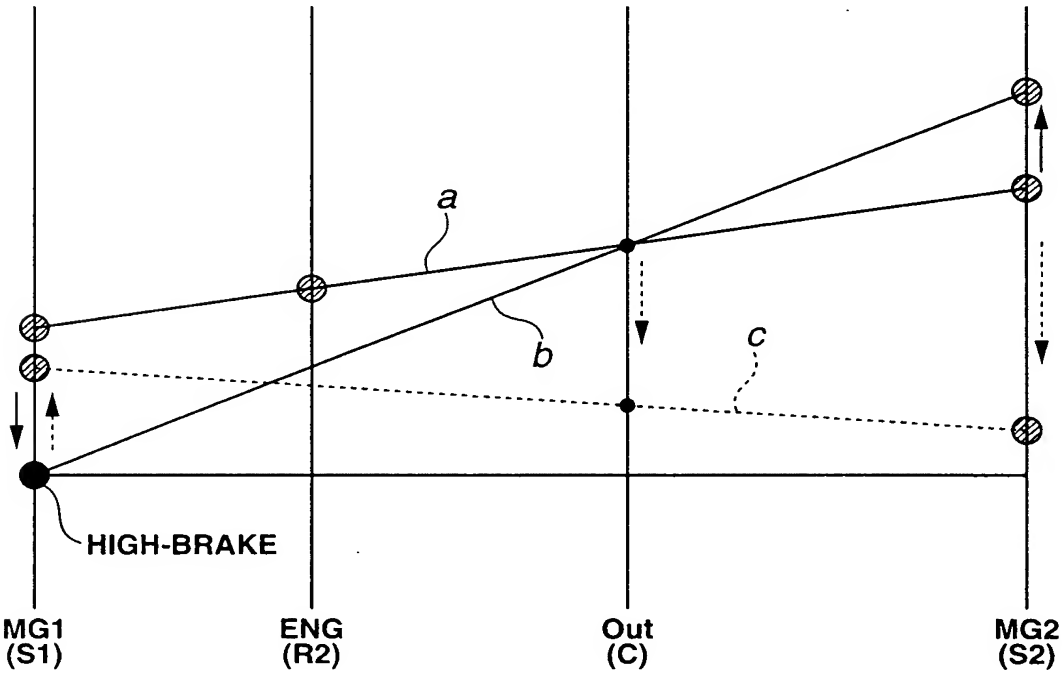

a
b
c
HIGH-BRAKE
MG1
(S1)
ENG
(R2)
Out
(C)
MG2
(S2)

FIG.10

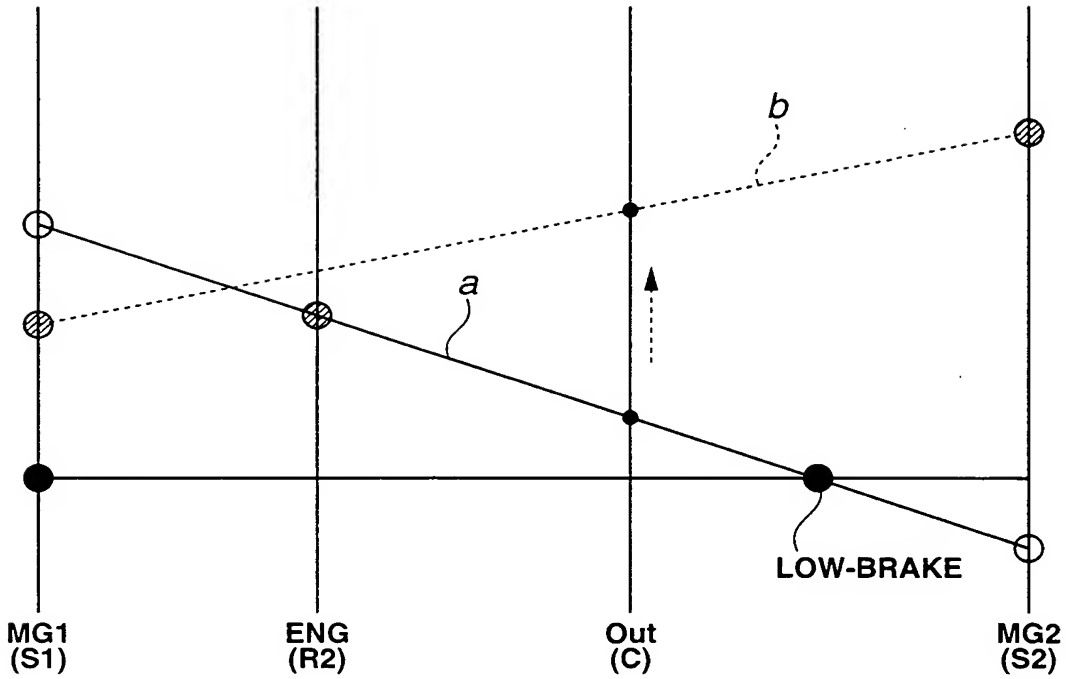

b
a
LOW-BRAKE
MG1
(S1)
ENG
(R2)
Out
(C)
MG2
(S2)

FIG.11

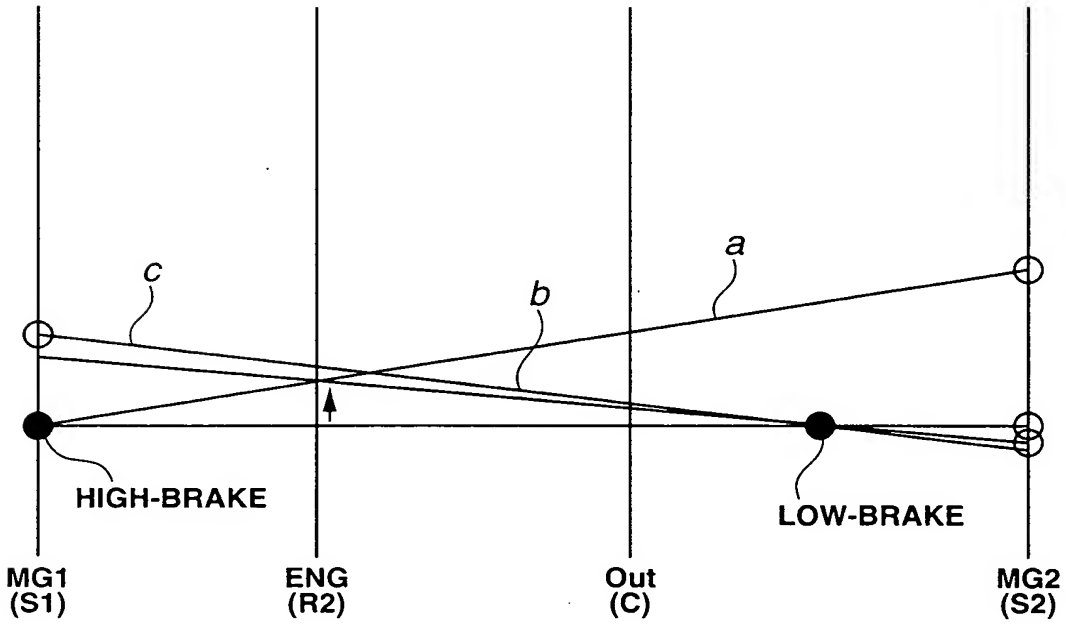

c
b
a
HIGH-BRAKE
LOW-BRAKE
MG1
(S1)
ENG
(R2)
Out
(C)
MG2
(S2)

FIG.12

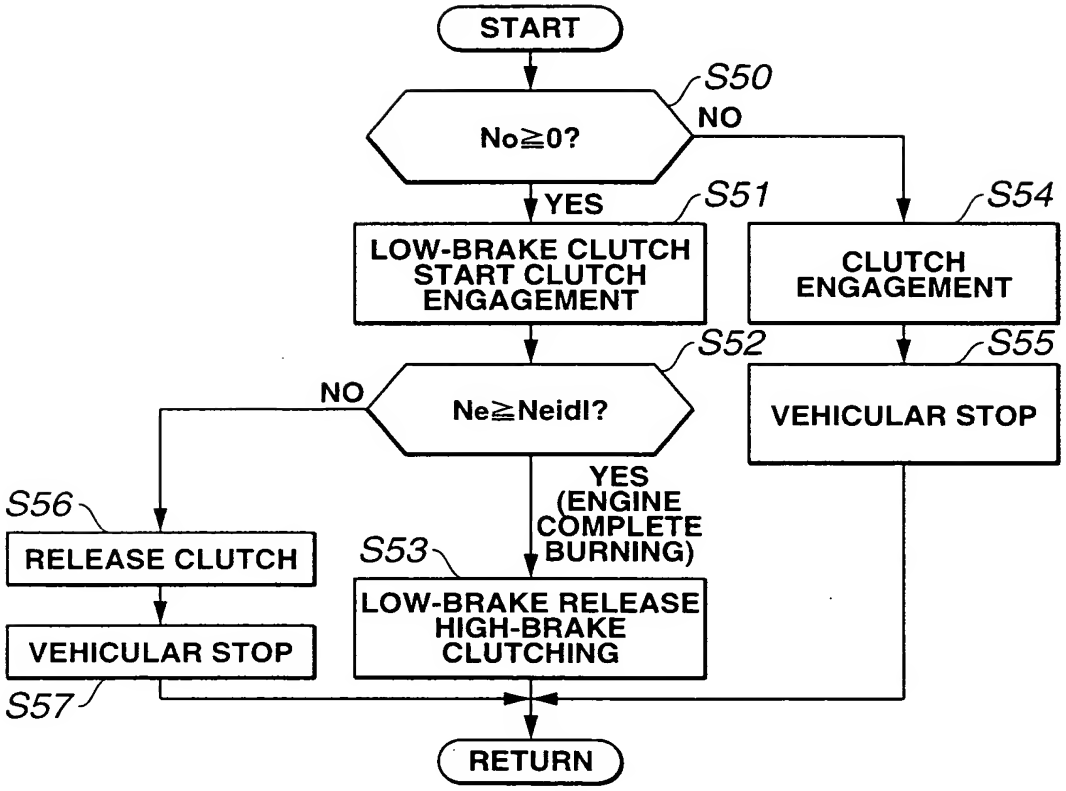

START
S50
No≧0?
NO
YES
S51
LOW-BRAKE CLUTCH START CLUTCH ENGAGEMENT
S54
CLUTCH ENGAGEMENT
S52
Ne≧Neidl?
NO
S55
VEHICULAR STOP
YES (ENGINE COMPLETE BURNING)
S56
RELEASE CLUTCH
S53
LOW-BRAKE RELEASE HIGH-BRAKE CLUTCHING
VEHICULAR STOP
S57
RETURN

FIG.13

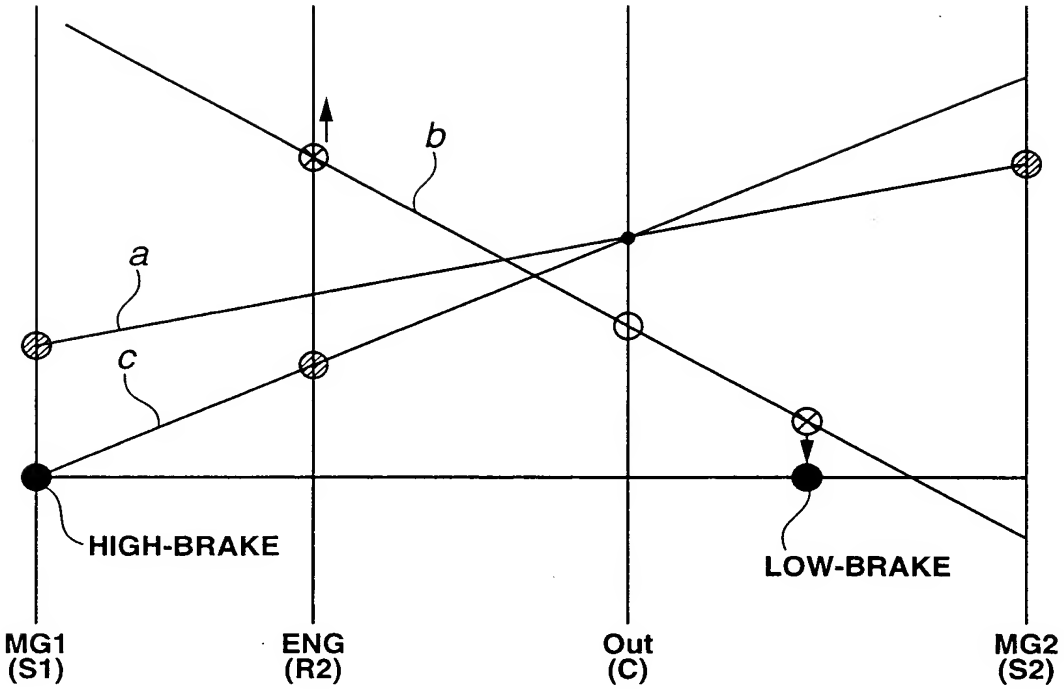
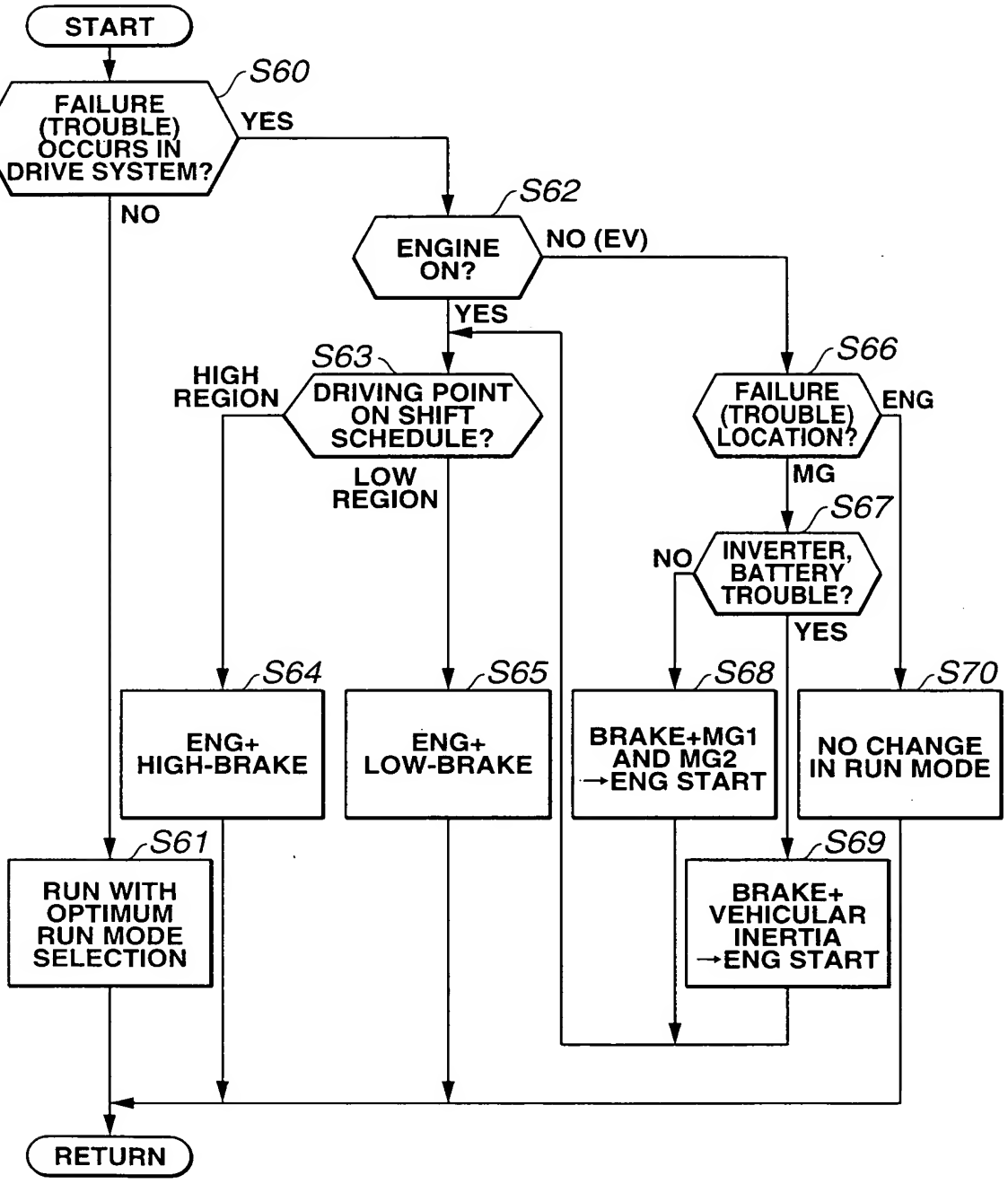


FIG.14


START
S60
FAILURE (TROUBLE) OCCURS IN DRIVE SYSTEM?
YES
NO
S62
ENGINE ON?
NO (EV)
YES
S63
HIGH REGION
DRIVING POINT ON SHIFT SCHEDULE?
LOW REGION
S66
FAILURE (TROUBLE) LOCATION?
ENG
MG
S67
NO
INVERTER, BATTERY TROUBLE?
YES
S64
ENG+ HIGH-BRAKE
S65
ENG+ LOW-BRAKE
S68
BRAKE+MG1 AND MG2 →ENG START
S70
NO CHANGE IN RUN MODE
S61
RUN WITH OPTIMUM RUN MODE SELECTION
S69
BRAKE+ VEHICULAR INERTIA →ENG START
RETURN

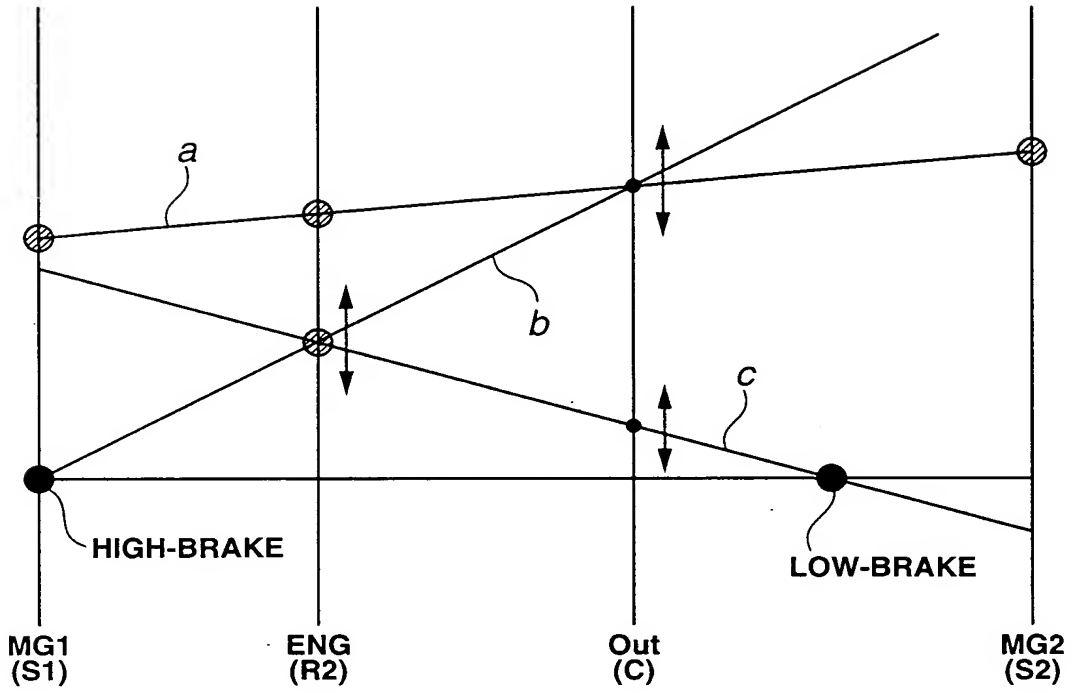



FIG.15